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DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

BY EDWARD CLODD.

V.

THE confusion in the barbaric mind between the objective and the subjective, and between the name and the person or thing, which has been illustrated in the foregoing chapters, will enable us to see more clearly how the like confusion must enter into the interpretation of such occult and compound phenomena as dreams, and all their kind.

They supply the conditions for exciting and sustaining that feeling of mystery which attends man's endeavour to get at the meaning of his surroundings. The phantasies which have defiled through the brain in coherent order, or danced in mazy whirl about its sinuous passages when complete sleep was lacking, leave their footprints on the memory, and they are strong of head and heart, true pepticians, like the countryman cited by Carlyle, who, "for his part, had no system," whose composure on awaking is not affected by the harmonious or discordant, the pleasant or disagreeable illusions which have made up their dreams. In the felicitous words of Lucretius, "when sleep has chained down our limbs in sweet slumber, and the whole body is sunk in profound repose, yet then we seem to ourselves to be awake and to be moving our limbs, and amid the thick darkness of night we think we see the sun and the daylight; and though in a confined room, we seem to be passing to new climates, seas, rivers, mountains, and to be crossing plains on foot, and to hear voices, though the austere silence of night prevails all round, and to be uttering speech, though quite silent. Many are the other things of this marvellous sort we see, which all seek to shake, as it were, the credit of the senses: quite in vain, since the greatest part of these cases cheat us on account of the mental suppositions which we add of ourselves, taking those things as seen which have not been seen by the senses. For nothing is harder than to separate manifest facts from doubtful, which the mind without hesitation adds on of itself."*

**De rerum Natura*, B. IV. ll. 453-468.

While for us dreams fill an empty moment in the telling, albeit now and again nurturing such remains of superstition as cling to the majority of people, they are to the untrained intelligence, unable to distinguish fact from fiction, or to follow any sequence of ideas, as solid as the experiences of waking moments. As a Zulu, well expressing the limits of savage thought, said to Bishop Callanay, "Our knowledge does not urge us to search out the roots of it, we do not try to see them, if anyone thinks ever so little, he soon gives it up, and passes on to what he sees with his eyes; and he does not understand the real state of even what he sees." Nor does his language clear the confusion within when he tells what he has seen and heard and felt, where he has been and what he has done, for the speech cannot transcend the thought, and therefore can represent neither to himself nor to his hearers the difference between the illusions of the night and the realities of the day. The dead relatives and friends who appear in dreams and live their old life, with whom he joins in the battle, the chase, and the feast, the foes with whom he struggles, the wild beasts from whom he flees, or in whose clutches he feels himself, and with shrieks awakens his squaw, the long distances he travels to sunnier climes lit by a light that never was on land or sea, are all real, and no "baseless fabric of a vision." That now and again he should have walked in his sleep, would confirm the seeming reality; still more so would the intensified form of dreaming called "nightmare," (or night-spirit) when hideous spectres sit upon the breast, stopping breath and paralysing motion, and to which is largely due the creation of the vast army of nocturnal demons that fill the folk-lore of the world, and that, under infinite variety of repellent form, have had place in the hierarchy of religions.

Dreams are in the main referred by the savage either to the entrance into him of some outside spirit—as among the Fijians, who believe that the spirit of a living man will leave the body to trouble sleeping folk—or to the real doings of himself.

When the Greenlander dreams of hunting, or fishing, or courting, he believes that the soul quits the body; the Dyaks of Borneo think that during sleep the soul sometimes remains in the body or travels far away, being endowed, whether present or absent, with conditions which in waking moments are lacking. Wherever we find a low state of mental development the like belief exists. In Mr. im Thurn's elaborate work on the Indians of Guiana, already reviewed in this journal, we have corroborative evidence, the more valuable because of its freshness. He tells us that the dreams which come to the Indian are to him as real as any of the events of his waking life. To him dream-acts and waking-acts differ only in one respect—namely, that the former are done only by the spirit, the latter are done by the spirit in its body. Seeing other men asleep, and afterwards hearing from them the things which they suppose themselves to have done when asleep, the Indian has no difficulty in reconciling that which he hears with the fact that the bodies of the sleepers were in his sight and motionless throughout the time of supposed action, because he never question that the spirits, leaving the sleepers, played their part in dream-adventures. Mr. im Thurn illustrates the complete belief of the Indian in the unbroken continuity of his dream-life and waking-life by incidents which came under his own notice, and which are quoted as serving the argument of this paper better than any theorising.

"One morning when it was important to me to get away from a camp on the Essequibo River, at which I had been detained for some days by the illness of some of my Indian companions, I found that one of the invalids, a young

Macusi, though better in health, was so enraged against me that he refused to stir, for he declared that, with great want of consideration for his weak health, I had taken him out during the night and had made him haul the canoe up a series of difficult cataracts. Nothing could persuade him that this was but a dream, and it was some time before he was so far pacified as to throw himself sulkily into the bottom of the canoe. At that time we were all suffering from a great scarcity of food, and, hunger having its usual effect in producing vivid dreams, similar events frequently occurred. More than once, the men declared in the morning that some absent man, whom they named, had come during the night, and had beaten, or otherwise maltreated them; and they insisted on much rubbing of the bruised parts of their bodies. Another instance was amusing. In the middle of one night I was awakened by an Arawak named Sam, the captain or head-man of the Indians who were with me, only to be told the bewildering words, 'George speak me very bad, boss; you cut his bits!' It was some time before I could collect my senses sufficiently to remember that 'bits,' or fourpenny-pieces, are the units in which, among Creoles and semi-civilised Indians, calculation of money, and consequently of wages, is made; that to cut bits means to reduce the number of bits, or wages, given; and to understand that Captain Sam, having dreamed that his subordinate George had spoken insolently to him, the former, with a fine sense of the dignity of his office, now insisted that the culprit should be punished in real life. One more incident, of which the same Sam was the hero, may be told for the sake of the humour, though it did not happen within my personal experience, but was told me by a friend. This friend, in whose employ Sam was at the time, told his man, as they sat round the fire one night, of the Zulu or some other African war which was then in progress, and in so doing inadvertently made frequent use of the expression, 'to punish the niggers.' That night, after all in camp had been asleep for some time, they were raised by loud cries for help. Sam, who was one of the most powerful Indians I ever saw, was 'punishing a nigger' who happened to be one of the party; with one hand he had firmly grasped the back of the breeches-band of the black man, and had twisted this round so tightly that the poor wretch was almost cut in two. Sam sturdily maintained that he had received orders from his master for this outrageous conduct, and on inquiry, it turned out that he had dreamed this."*

Taking an illustration from nearer home, although from a more remote time, we have in the Scandinavian Vatnsdæla Saga a curious account of three Finns who were shut up in a hut for three nights, and ordered by Ingimund, a Norwegian chief, to visit Iceland, and inform him of the line of the country where he was to settle. Their bodies became rigid, and they sent their souls on their errand, and, on their awaking at the end of three days, gave an accurate account of the Vatnsdal, in which Ingimund ultimately dwelt. No wonder that in mediæval times, when witches swept the air and harried the cattle, swooning and other forms of insensibility were adduced in support of the theory of soul-absence, or that we find among savages—as the Tajals of the Luzon islands—objections to waking a sleeper lest the soul happens to be out of the body. As a corollary to this belief in soul-absence, fear arises lest it be prolonged to the peril of the owner, and hence a rough and ready theory of the cause of disease is framed, for savages rarely die in their beds.

That disease is a derangement of functions interrupting their natural action, and carrying attendant pain as its indication, could not enter the head of the uncivilised; and, indeed, among ourselves a cold or a fever is commonly thought of as an entity in the body which has stolen in, and, having been caught, must be somehow expelled. With the universal primitive belief in spiritual agencies everywhere inhaled with the breath or swallowed with the food or drink, all diseases were regarded as their work, whether, as remarked above, through undue absence of the rightful spirit or subtle entrance of some hostile one. If these be the causes to which sicknesses are due, obviously the only cure is to get rid of them, and hence the sorcerer and the medicine-man find their services in request in casting out the demon by force, or enticing him by cajolery, or in bringing back the truant soul.

* "Among the Indians of Guiana," pp. 344-346.

THE ANTARCTIC REGIONS.

By Richard A. Proctor.

(*Continued from p. 56.*)

If we consider the nature of the Antarctic Seas, and particularly the circumstance that the Antarctic summer is far colder than the Arctic summer, it will appear most probable that within the Antarctic regions land and water are so distributed that, while the shore-lines are of great extent, there is very free communication with the open Antarctic Ocean. In other words, it seems reasonable to conclude that there are many large islands within the Antarctic circle, that these islands are separated from each other by wide passages, and not by straits readily blocked up and encumbered with ice in such sort as to impede the outward passage of the great icebergs. And nothing which has been ascertained by Antarctic voyagers is opposed to this conclusion. It is, indeed, very easy to fall into the mistake of inferring otherwise from the study of an ordinary chart of the Antarctic seas. If, for example, we look at the chart in Maury's "Physical Geography of the Sea," we are apt to imagine that the boundary line indicating the limits of Antarctic explorations points to the existence of a continuous barrier of ice, the advanced line of defence, as it were, behind which lies as continuous a barrier of precipitous shore-line. But a very slight study of the records of Antarctic voyages will suffice to show how erroneous is such an impression. We find that long before coast-lines have been seen, the hardy voyagers have found themselves impeded and often surrounded by masses of floating ice. Wilkes, Ross, and D'Urville, when struggling to advance towards the southern pole, were repeatedly compelled to retreat without seeing any signs of land. Land has not been seen, indeed, along more than one-sixth part of the circuit of the Antarctic barrier, and it has only been in the neighbourhood of Victoria Land that a continuous coast-line of any considerable extent has been discovered. Wherever land has been seen, it has been mountainous and rugged—a circumstance which suggests great irregularity of outline in the land-regions, and the high probability that these regions are broken up into islands resembling those in the north-polar seas.

Certainly, there is much in what has been learned or may be inferred respecting the Antarctic regions, to suggest the wish that further explorations may one day be undertaken. When we consider what has been done with sailing-ships, it seems by no means unlikely that with steam-ships suitably constructed the Antarctic seas might be successfully explored. I would not encourage the idle ambition to penetrate so many miles farther southward than has hitherto been found practicable. But there are many and legitimate

considerations in favour of further exploration. "Within the periphery of the Antarctic circle," says Captain Maury, "is included an area equal in extent to one-sixth part of the entire land surface of our planet. Most of this immense area is as unknown to the inhabitants of the earth as the interior of one of Jupiter's satellites. With the appliances of steam to aid us, with the lights of science to guide us, it would be a reproach to the world to permit such a large portion of its surface any longer to remain unexplored. For the last 200 years, the Arctic Ocean has been a theatre for exploration; but as for the Antarctic, no expedition has attempted to make any persistent exploration, or even to winter there. England, through Cook and Ross; Russia, through Billingshausen; France, through D'Urville; and the United States, through Wilkes, have sent expeditions to the South Sea. They sighted and sailed along the icy barrier, but none of them spent the winter, or essayed to travel across and look beyond the first impediment. The expeditions which have been sent to explore unknown seas have contributed largely to the stock of human knowledge, and they have added renown to nations, lustre to diadems. Navies are not all for war. Peace has its conquests, science its glories; and no navy can boast of brighter honours than those which have been gathered in the fields of geographical exploration or physical research."

It does not appear that Antarctic voyages would be attended with any excessive degree of danger. No ship has hitherto been lost, I believe, in explorations beyond the Antarctic circle. It may be said, indeed, that such attempts are rather arduous than dangerous. It may even be found that the Antarctic barriers are impenetrable, but this has certainly not as yet been demonstrated. And it is far from being improbable that, if success could be achieved, an important field of commercial enterprise would be opened. The Antarctic regions are not mere desert wastes. The seamen under Ross found Possession Island covered by penguins standing in ranks like soldiers, and too little familiar with the ways of man to attempt escape. More valuable animals live and thrive, however, in Antarctic seas. Whales and seals exist there in abundance, and, as Captain Maury has well remarked, "of all the industrial pursuits of the sea, the whale fishery is the most valuable." In Arctic fisheries, he tells us, three thousand American vessels are engaged, and "if to these we add the Dutch, French, and English, we shall have a grand total of perhaps not less than six or eight thousand, of all sizes and flags, engaged in this one pursuit." There are reasons for believing that whale-fisheries in Antarctic regions would afford a richer, as they would certainly afford a far wider, field for maritime enterprise.

SENSATION IN A SEVERED HEAD.

DURING the murderous horrors of the great Revolution stories were current of heads retaining consciousness and sensibility after the guillotine had separated them from the bodies of the victims, and it has been a question of interest to physiologists and philanthropists how soon absolute death supervenes upon decapitation. A curious case is mentioned in our issue for June 27, but later observations and experiments have been published.

On the 30th April last, a criminal, whose real name was not revealed, but who went under that of Campi, was executed in Paris, and arrangements were made by M. Laborde to experiment with his remains. A curious custom prevented the doctor from receiving his subject until a funeral service had been performed at a cemetery, and thus an hour and twenty minutes elapsed between the fall of the knife and the beginning of the experiments, of which a full account will be found in the *Revue Scientifique* for the 21st of June. While assistants were connecting the carotid artery of a dog with the severed artery of the head in order to supply it with the stimulus of freshly-circulating blood, M. Laborde endeavoured to excite the spinal marrow by electric shocks, but without effect, whether he operated upon the portion connected with the trunk, or upon that of the head. The muscular system responded to the electric excitation, but the nervous system was impassive—it had become totally and irrecoverably insensible an hour and a half after the decapitation. M. Laborde's conclusion was that "the nervous tissue in general is the first to lose its power when the circulation is stopped, and that the head is the first part of it to be dispossessed of its functions.' "In order," he said, "to restore to this organ perception and consciousness, it would be necessary not only to replace experimentally its conditions of circulation, but to do so as quickly as possible, before there was time for a definite and irremediable loss of functional power."

But, however interesting to science, both humanity and morality would be shocked if any wretched victim of the law were recalled to even momentary life and suffering.

The failure of the experiments with Campi led to an abominable trial with a dog, subjected to decapitation and transfusion of blood, when the animal is reported to have recognised a familiar voice by a smiling motion of its mouth. More lately, M. Petitgand has contributed to these inquiries observations he made in 1875, when witnessing the execution of an Annamite at Saïgon. According to his account in the *Revue Scientifique* for July 5, the execution took place on the sandy Plain of the Tombs, the cemetery for the Annamites and Chinese. Four pirates, captured in arms, were the sufferers. Their chief was a strong man in the prime of life, and meeting his fate with calm courage, the doctor determined to keep his eyes fixed upon him. According to the local mode of execution, the prisoner has his hands tied behind him and fastened to a post. He has then to kneel down and bend his head, so as to stretch the intervertebral substance as much as possible, and if the victim shrinks, an assistant holds him in the right position by his long hair. In this case no such aid was required. The executioner marked the spot he wished to strike with betel juice, and then, with the sweep of a long, broad, and thin sabre, effected his business at one stroke. M. Petitgand remarks that, when decapitation is skilfully performed in this manner, there is no contusion of the spinal marrow, which occurs with the guillotine, unless it happens to cut neatly through an intervertebral disk. When the head is roughly severed, as in Campi's case, he supposes the shock so stupefies the nervous centres as to render any subsequent manifestation of function of the brain quite impossible.

In the Annam case he did not for an instant lose sight of the condemned man, but addressed some words concerning him to the officer superintending the execution, in a loud voice. He noticed, also, that the patient examined him with the most lively attention. When the preparations were finished, the doctor retired a couple of mètres, and the victim, before bowing his head, exchanged glances with him. The head fell less than two mètres from him, and did not roll as usual, but stood upright on the sand, which reduced the hæmorrhage to a minimum. "At this moment," exclaims the doctor, "I was alarmed to see the eyes of the victim fixed upon mine. Hesitating to believe this a manifestation of consciousness, I moved quickly in a quarter-circle round the head, and I can affirm that the

eyes followed me. I then returned to my first position, moving more slowly. The eyes still followed for a very brief moment, and then suddenly left me. The face, at this instant, expressed manifest anguish—the poignant agony of a person suffering acute asphyxia. The mouth opened visibly, as if struggling for air; the head then lost its balance and rolled on one side, the contraction of the maxillary muscles being the last sign of life. From fifteen to twenty seconds had expired."

M. Petitgand considers that when a head is separated from a body, and the loss of blood does not exceed certain limits, and it contains sufficient oxygen to stimulate the nervous function, sensation may last for possibly half a minute. Thus, in certain cases, beheading may be a barbarous punishment, and "the patient may be conscious some time after his execution; but, in a great majority of cases, fears of such a survival are chimerical. It is almost impossible that the vertebral column, struck obliquely by the knife of the guillotine, should not occasion a shock sufficient to suspend all the cerebral functions." In the case of the Annamite, the heart made twelve or fifteen pulsations after the severance of the head.

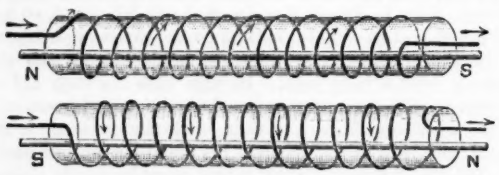
It may be concluded from these observations of M. Petitgand that the hanging of criminals in the manner now practised in this country must produce immediate insensibility, as the dislocation of the spine must occasion the violent shock which he believes instantly paralyses the nervous system. S.

THE ELECTRO-MAGNET.

By W. SLINGO.

(*Continued from p.* 30.)

A LITTLE careful study of the two small diagrams (Figs. 1 and 2) which appeared in the previous article (and which are here reproduced for the sake of reference) will have made clear the distinction between a



Figs. 1 and 2.

right and a left handed helix. The idea is perhaps more easily grasped by a reference to the accompanying additional illustration (Fig. 3), where both modes of winding

Fig. 3.

are applied to a single coil. The winding commencing at N, the first half of the coil, N S, is a left-handed helix, while the second half, S N′, is a right-handed helix. It will be seen that at S the wire is turned back on itself, and the direction of winding reversed.

Now for the polarity induced. The arrows in each case indicate the direction taken by the current. Thus in Fig. 1 the current enters at the end marked N, and passes round the glass in the opposite direction to that taken by the hands of a clock. Remembering, however, what was said about the little man swimming with the current, that is, that when facing the iron or the axis of the coil, the north pole would be on his left hand, we can easily determine the polarity of the helix and the iron embraced by it. Thus, if we imagine the little man to be in the upper portion of the first ring or loop, he must, to follow out the conditions referred to, lie face downward with his head in the direction of the retreating current (or away from the reader's eye). Clearly his left hand will be towards N, and his right hand towards S. Supposing the miniature man to be in any other portion of the ring, he will still have his left hand N-wards, and consequently every ring or every fraction of a ring helps to increase the intensity of magnetisation. It may, however, be observed that the rings are not perfect, but that in passing from one ring to the next there is a slight longitudinal deviation. The sum total of these deviations, supposing the iron rod to be covered from end to end, is equal, evidently, to a single wire the length of the coil, or of its iron core. The effect of such a wire would be exerted at right angles to that of the series of rings; but inasmuch as the single wire is materially less effectual than the rings, and for other reasons which need not here be dwelt upon, such an antagonistic tendency as that exerted by the wire is so infinitessimal as to be lost sight of. Thus, then, in a left-handed helix the end where the current enters becomes a north pole, the other end becoming a south pole.

Conversely it will be seen that in Fig. 2, where there is illustrated a right-handed helix, the arrows indicate that the current pursues the same direction as the watch-hands (viewed from the end at which the current enters), and that to comply with Ampere's conditions the little man in the upper portion of any loop or ring must lie face downwards, with his head towards the reader, when his left hand will be extended towards the extremity of the iron rod marked N, or in the opposite direction to that indicated in the previous figure. The polarity of the iron rod is therefore reversed, and it may be well to note that with a right-handed helix the point of entry becomes a south pole, the other end becoming consequently a north pole.

But now the interesting question presents itself: What is the effect of changing the heliacal direction, or the direction of winding around one and the same core? To take the simplest case, we may place a left and a right-handed helix end to end on a common core, and then, joining them together, we shall get a result resembling the accompanying illustration (Fig. 3). Here the current enters a left-handed helix at N, but at S it leaves the left-handed and enters a right-handed helix, through which it passes, emerging at N′. In this case, the coil and its core have three poles, one south and two norths, and a little reflection or re-perusal of what has been previously said will make clear the appearance of a south polarity at S, due in the first place to the current emerging from a left-handed helix, and strengthened by the current entering a right-handed helix. In both cases the tendency is to create this south pole. Similarly, the two extremities of the core become north poles on account of the current at N entering a left-handed helix, and at N′ leaving a right-handed helix. It may be as well to point out here that, although we may maintain that the two magnetic conditions are equal in every magnet, it does not follow that every magnet contains or possesses only two poles at the extremities separated in the centre by a neutral line or zone. This idea is more prevalent than most people imagine, and it is on this account that the point is here referred to. We may introduce as many extra or "consequent" poles (as they are styled) as we please, bearing in mind, however, that every two north or every two south poles will be separated by a south or a north pole, as the case may be, and that

between every two poles there is a region of neutrality—neutral, not in consequence of the absence of magnetism, but because the two poles are opposite and equal. We are furthermore accustomed to say, and that truly, that the two polarities in any magnet are equal, and for this, if for no other reason, neither of the north polarities (Fig. 3) can equal the south polarity. Were we able to eliminate every modifying influence, we should find that the single south pole equalled in strength the sum of the two norths.

These effects may be easily and effectively obtained by coiling a little wire around a knitting-needle and sending a current through it. The needle being steel, it will retain the magnetism induced, and by placing its various parts in in the neighbourhood of one or other of the poles of a suspended or floating magnet, experimental confirmation of its assumed magnetic condition may be afforded.

Supposing, in the next place, that our battery-power is limited, and that the effect produced by sending the current through a single helix (such as Figs. 1 or 2) is incapable of performing a certain task, the question arises: How are we to increase the magnetic effect exerted upon the iron without submitting to a corresponding increase in the battery-strength? This may be attained by increasing the coil of wire, or, in other words, by increasing the number of turns or loops. Presuming the coil to be closely wound, it is only possible to increase the number of turns in a single helix by using a thinner wire. It must, however, be borne in mind that by so doing we shall materially raise the resistance in circuit, and consequently cause a proportional diminution in the strength of the current traversing it. Thus, supposing that we substitute a wire half the diameter of that previously used, we should be able to envelope the core with, approximately, twice the number of rings or loops. This means twice the length of wire; and the resistance offered by a piece of wire varies directly as its length—or, more simply, twenty yards of wire offer twice the resistance that would be presented by only ten yards. But this is not all, for resistance also varies inversely as the cross section, which is the same as saying that it varies inversely as the square of the diameter. Now our thinner wire has only half the diameter of the other, or their diameters are as 1:2, the squares of which are 1 and 4. Thus, for equal lengths of the thin and thick wires the respective resistances will be 4 and 1. But it was said that the iron core would carry twice the length of thin wire, so that the resistance of such a helix would be eight times as great as the one composed of the thicker wire. The effect upon the current-strength is easily seen. Suppose we have two cells giving an electro-motive force of two volts, and having an internal resistance of 1 ohm per cell. Then, with the stout wire helix having a resistance of, say, 1 ohm, we get, according to Ohm's law (which declares that the current produced varies directly as the electro-motive force (E), and inversely as the total resistance, including that of the battery (r) and of the external circuit (R)),

$$\frac{E}{R+r}=\frac{4}{1+2}=1\cdot\dot{3}.$$

And with the thin wire helix (having eight times the resistance of the other, and therefore offering 8 Ohms) we get:—

$$\frac{E}{R+r}=\frac{4}{8+2}=\cdot4.$$

The bearing of these figures in demonstrating that in the second case we get less magnetic force developed than in the first case may be readily seen, and will be dealt with next.

(To be continued.)

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

BY MONS. DE FONTENELLE.

WITH NOTES BY RICHARD A. PROCTOR.

(Continued from p. 44.)

"ALL philosophy," said I, "madam, is founded upon two things, either that we are too short-sighted, or that we are too curious; for if our eyes were better than they are we should soon see whether the stars were worlds or not; and if, on the other hand, we were less curious, we should not care whether the stars are worlds or not, which, I think, is much to the same purpose. But the business is, we have a mind to know more than we see. And, again, if we could discern well what we do see, it would be too much known to us; but we see things quite otherwise than they are. So that your true philosopher will not believe what he does see, and is always conjecturing at what he does not, which is a life, I think, not much to be envied. Upon this I fancy to myself that nature very much resembles an opera; where you stand, you do not see the stage as it really is, but as it is placed with advantage, and all the wheels and movements are hid, to make the representation the more agreeable. Nor do you trouble yourself how or by what means the machines are moved, though certainly an engineer in the pit is affected with what does not touch you; he is pleased with the motion, and is demonstrating to himself on what it depends, and how it comes to pass.

"This engineer, then, is like a philosopher, though the difficulty is greater on the philosopher's part, the machines of the theatre being nothing so curious as those of Nature, who disposes her wheels and springs so out of sight that we have been long a guessing at the movement of the universe. Suppose, then, the sages to be an opera—*i.e.*, Pythagoras, Plato, Aristotle, and all the wise men who have made such a noise in the world for these many ages; we will suppose them at the representation of Phæton, where they see the aspiring youth lifted up by the winds, but do not discover the wires by which he mounts, nor know they anything of what is done behind the scenes. Would you have all these philosophers own themselves to be stark fools, and confess ingeniously they know not how it comes to pass? No, no, they are not called wise men for nothing; tho', let me tell you, most of their wisdom depends upon the ignorance of their neighbours. Every man presently gives his opinion, and how improbable soever, there are fools enough of all sorts to believe 'em: One tells you Phaeton is drawn up by a hidden magnetick virtue, no matter where it lies; and perhaps the grave gentleman will take pet if you ask him the question. Another says Phaeton is compos'd of certain numbers that make him mount; and, after all, the Philosopher knows no more of those numbers than a sucking child does of Algebra. A third tells you, Phaeton hath a secret love for the top of the theatre; and, like a true lover, cannot be at rest out of his mistress's company; with an hundred such extravagant fancies, that a man must conclude the old sages were very good banterers.

"But now comes Monsieur Descartes with some of the moderns, and they tell you Phaeton ascends, because a greater weight than he descends; so that now we do not believe a body can move unless it is push'd and forc'd by another body, and as it were drawn by cords, so that nothing can rise or fall but by means of counter-poise; to

see nature, then, as she really is, you must stand behind the scenes at the opera."

"I perceive," said the Marchioness, "philosophy is now become very mechanical." "So mechanical, madam," said I, "that I fear we shall quickly be ashamed of it; they will have the world to be in great, what a watch is in little, which is very regular, and depends only upon the just disposing of the several parts of the movement. But pray tell me, madam, had you not formerly a more sublime idea of the universe? Do not you think then that you honour'd it more than it deserv'd? for most folks have the less esteem for it since they have pretended to know it."

"I am not of their opinion," said she; "I value it the more since I know it resembles a watch; and the whole order of nature, the more plain and easy it is, to me it appears the more admirable."

"I know not," said I, "who has inspired you with these solid notions, but I am certain there are few that have them besides yourself. People generally admire what they do not comprehend, they have a veneration for obscurity, and look upon nature, while they do not understand her, as a kind of magic, and despise her below legerdemain, when once they are acquainted with her: but I find you, madam, so much better disposed, that I have nothing to do but to draw the curtain and shew you the world.

"That then which appears farthest from the earth (where we reside) is called the heavens, that azure firmament, where the stars are fasten'd like so many nails, and are call'd fix'd, because they seem to have no other motion than that of their heaven, which carries them with itself from east to west. Between the earth and this great vault (as I may call it) hang at different heights,* the sun, and the moon, with the five other stars, Mercury, Venus, Mars, Jupiter, and Saturn, which we call the planets: these planets, not being fastened to the same heaven, and having very unequal motions, have diverse aspects and positions; whereas the fixed stars in respect to one another, are always in the same situation: for example, the Chariot, which is compos'd of the seven stars, has been, and ever will be,† as it now is, tho' the moon is sometimes nearer to the sun, and sometimes farther from it; and so it is with the rest of the planets. Thus things appear'd to the old Chaldean shepherds, whose great leisure produced these first observations, which have since been the foundation of astronomy; which science had its birth in Chaldea, as geometry sprung from Egypt, where the inundation of the Nile confounding the bounds of the fields, was the occasion of their inventing exacter measures, to distinguish every one's land from that of his neighbour. So that astronomy was the Daughter of Idleness, Geometry the daughter of Interest; and if we did but examine Poetry, we should certainly find her the Daughter of Love."

"I am glad," said the lady, "I have learnt the genealogy of the sciences, and am convinced I must stick to astronomy; my soul is not mercenary enough for geometry, nor is it tender enough for poetry; but I have as much time to spare as astronomy requires; besides, we are now in the country, and lead a kind of pastoral life, which suits best with astronomy."

"Do not deceive yourself, madam," said I, "'tis not a true shepherd's life to talk of the stars and planets: see if they pass their time so in Astræa."

"That sort of shepherd's craft," replied she, "is too dangerous for me to learn: I love the honest Chaldeans, and you must teach me their rules if you would have me improve in their science. But let us proceed."

(To be continued.)

* The use of the word height by the old astronomers where we say distance illustrates curiously the former prevalence of the old idea of a flat earth.—R. P.

† The proper motion of the stars had however been already detected by Halley when this was written, and the absolute fixity of the stars and unchangeableness of the constellations could no longer be asserted.—R. P.

NOVEL TRICYCLES.

By JOHN BROWNING,

(Chairman of the London Tricycle Club.)

NOT contented with the important improvements he has introduced in rear-steering tricycles, Mr. Rucker is bringing forward a new machine which will in my opinion eclipse all he has hitherto done, and possibly all that other makers have done in this direction.

It is well known that Mr. Rucker has for some time made an excellent front-steerer with central gearing.

The new rear-steering tricycle is also central-geared, and, with great ingenuity, a single vertical tube is made to carry both the seat-rod and saddle, as well as the lower chain-wheel bracket and pedals; and it will shortly be made to carry the steering-rod centrally arranged so as to allow the machine to be open to mount or dismount from it in the rear on either side.

It is easy to dismount from this machine in front, if it should be found necessary to do so.

The machine is very light, drives easily up hills, and is as safe as a hind-steerer can be made; that is to say, that any person with a few hours' practice can ride down a tolerably steep hill at the rate of from six to eight miles an hour, and a skilful rider at the rate of from ten to twelve miles an hour, and I think there are very few riders who would wish to do more.

There has been a great demand this year for "Tandems," particularly for "Convertible Tandems." Messrs. Hillman, Herbert, & Cooper have produced a new machine of this class, which they have named the "Kangaroo" Tandem.

The construction of this machine is very simple. The steering-wheel of a front-steering tricycle is removed, and replaced by the driving-wheel and back-bone of a "Safety" bicycle with a 36-in. driving-wheel, which is geared up by means of chains, so as to run at the same speed as the driving-wheels of the tricycle behind it. Of course, this bicycle portion requires no hind wheel, as it is supported by the front part of the framework of the tricycle. The steering is done entirely by the front rider, who should, I think, have also a good break under his control.

The machine I saw weighed about 120 lb., but a machine could, I should suppose, be made for careful riders to weigh less than 100 lb. if it were required.

The "Kangaroo" Tandem possesses several important advantages over most other tandems. The riders do not sit so close behind each other as to look uncomfortable. The machine is light. It can have two breaks instead of relying upon one. It has no small steering-wheel, and thus has less friction and less vibration than those machines which have, and, with the addition of a small hind wheel to the front portion, it can be converted in a few minutes into two complete machines, *i.e.*, an excellent safety bicycle and a first-class front-steering "Premier" tricycle.

Mr. Rucker has just completed for me one of his new two-chain two-speed machines, to my own specification. It is the most perfect front-steering machine I have yet ridden, answering in every respect my utmost anticipations.

As regards speed, I can drive the new "Rucker" quite as fast as what I have been accustomed to regard as my inimitable little "Humber," for I have ridden three miles

in a quarter of an hour on the main Brighton road between Crawley and Reigate; and I have also ridden 15 miles of rather rough and hilly by-roads at the rate of nearly 10 miles an hour. Probably I should not be able to maintain the same steady rate of speed as I can on the "Humber," because the "Rucker" weighs full 25 lb. more than the "Humber," and weight tells in time. But the low-speed, or hill-riding gear, will give the heavier machine a great advantage. My "Humber" is geared to 48 in., the same as the high gearing of the "Rucker." On this, after I have ridden from 30 to 50 miles, hills begin to tell upon me if at all steep. With the "Rucker" I can drop down to the low gearing, which is about 33 in., and get over a stiff hill without any particular strain. This will allow me to ride much farther without getting tired than I should be able to do if I were compelled to keep riding always with the high gearing.

The pace at which I can drive the new machine I believe to be due partly to the fact that I can ride it with the saddle farther in front of the pedals than I can on the "Humber," on which, though I ride almost leaning against the handle-bar and with my legs occasionally quite touching the axle (on this point I am quite certain) I yet feel that I should like to be farther in front of my pedals.

I fear that some of my readers will come to the conclusion that with me the last machine is always the best. Lest this should be thought the case, I would beg to point out that for each machine I order I draw the specification so that it shall avoid disadvantages I have experienced with previous machines, and possess special advantages of its own; and again, that I am precluded from saying anything here about machines I have tried and found wanting, as the publication of such remarks might cause serious inconvenience to the editor. The new Rucker has driving-wheels only 38 in. in diameter.

In my next article I shall give the results of my experience with other small-wheeled machines which I have been riding this season.

* * * *

Since writing the above I have ridden fifty miles with Mr. Arthur Salmon, one of the fastest riders in my club, for the purpose of testing the new machine. I rode from Reigate to Merstham, on through Redhill and Balcombe to Cuckfield and Lindfield—a series of hills; then returned over Hand Cross Hill to Crawley, back through Redhill to Reigate.

After riding about forty miles over this series of hills, I covered the ten miles from Crawley into Redhill, without making any perceptible effort, within an hour.

THE INTERNATIONAL HEALTH EXHIBITION.

IX.—WATER AND WATER-SUPPLIES—(*continued*).

THE quality popularly termed "hardness" has been most appropriately chosen to designate waters which offer a peculiar resistance to the sense of touch; it is a harsh or rough feeling when compared with the smooth gliding sensation experienced by the use of rain, or, as it has been called, "soft" water. The hardness is due to the presence of dissolved mineral salts, more notably to the carbonates and sulphates of lime and magnesia. It becomes distinctly appreciable when those salts obtain in quantities of over three or four grains in each gallon; and, in technical operations, it is customary to speak of the *degrees* of hardness in water, as determined by the "soap test." The unit of hardness is represented by the maximum amount of curdiness produced by one grain of chalk per gallon of water when soap is used. It is thus evident that before soap can be made available as a detergent, when used with a hard water, a certain amount is destroyed or decomposed by the substances which produce that hardness, and the waste so occasioned is directly proportional to the hardness of the water.

We have now reviewed all the most important factors which bear upon natural water-supplies, with the single exception of upland surface waters, excellent examples of which are to be found in those which feed the rivers and lakes of Cornwall, Devonshire, Northern England, Wales, and Scotland. In all the districts just enumerated, the gathering grounds are chiefly formed of igneous and metamorphic rocks and sandstones. The water thus differs widely from that which we considered in our last communication, in being characteristically soft. The upland waters of the Millstone Grit and non-calcareous parts of the Coal Measures, which supply portions of Yorkshire and Lancashire, are also particularly soft. But there are other British upland waters, which are decidedly calcareous; they are derived from the limestone and other formations which include the basins of the far-famed Trent, the Tyne, Mersey, Wear, Tees, Tweed, Forth, and Clyde. All these upland surface waters, however, are more or less tainted with harmless colouring matters and objectionable odours. These undesirable items are due to their percolation throughout superficial layers of the peat derived from the decayed remains of successive growths of shrubs, heather, grasses, mosses and other cryptogamic plants.

Lastly, the influence of man and other animals upon the water-supply demands our attention. The words guano-mounds, kitchen-middens, cesspools, and sewage are all suggestive of the presence of the "lords of creation"; but when we come to churchyards and cemeteries, it seems as though modern civilization had undergone a process of retrograde development. The refining influences of our social system have their drawbacks: they foster feelings which in themselves are noble in the ideal, but are too often proved to be practically pernicious, and even ghastly, in real life. In spite of the warnings of able geologists and doctors of medicine, the vast majority of persons in this country prefer to give their friends what they erroneously call a "Christian burial." When the ceremony is over, they little think that they have merely contributed their iota to a hotbed of festering filth, which has been shown over and over again to be only something short of a wholesale system of manslaughter. We have of late come into contact with many gravediggers and undertakers who loathe their trades so strongly, that nothing short of the hard struggle for existence keeps them to their uncoveted employments. How disgusting the disinterment of a leaden coffin, after perchance a lapse of some years, is, is perhaps only known to the few individuals whose unhappy lot is cast amongst the dead forgotten. Let us ask, with Dr. Attfield*:—"How much longer will a misguided sentiment, an ill-guided superstition, or simple ignorance, sanction the poison-breeding process of interment, when the highest religion and the best interests of humanity point to the harmless practice of cremation?"

To soothe the feelings of the bereaved, would it not be better and more worthy of their creed to follow the dictates of reason? If they desire to perpetuate the memory of beloved ones, how much wiser, to say the least of it, would it be to erect something of value to their fellow-beings. The drinking-fountain dedicated to Greyfriar's Bobby, in Edinburgh, might well be taken as an example in this

* "Water and Water-Supplies," &c., 1884, p. 3.

direction; and may we not hope that the time is at hand when pestiferous cemeteries, with their gloomy tombs, tablets, wreaths, and misshapen marble doves, will give place to drinking-fountains, seats for the weary and foot-sore, shelters and food for the houseless, and health and happiness for all?

The evil gases and germs arising from graveyards are only too manifest to those whose duty leads them perpetually to such scenes; not only does the air become vitiated, but the most serious cause for apprehension is to be sought for in the drainage. The rain-water carries the foul products from the atmosphere, and in greater abundance from the soil, into the underground circulation. If the strata happen to slope downwards to a district of water-supply from wells, the latter become perpetual sources of disease. To a less marked extent is the influence of man felt in the detorioration of water through cesspools and pits; yet they are oftentimes sources of great danger. See Fig. 18, which we avail ourselves of through the kindness of Mr. P. A. Maignen.

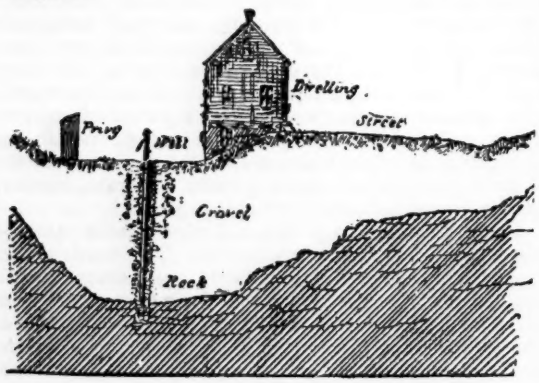


Fig. 18.—Reproduced from the Tenth Annual Report of the Massachussetts State Board of Health. There were twelve cases of typhoid fever among persons using this well water and the house became the centre of infection for a whole neighbourhood.

SAMPLES OF WATER.

We now propose to submit to our readers a series of samples of water, both natural and artificial, with a brief summary of their properties, as preliminary to a sketch of the methods employed to render them valuable for specific purposes. In doing so we shall have occasion to lead them once more to the collections at South Kensington, there to view the numerous apparatus and inventions which have been designed to secure the purification of waters.

1. NATURAL WATERS.—To this category belong the following types:—1. Ice and snow; 2. Rain, dew, and hoar-frost; 3. Marsh and Pond water; 4. Lake water; 5. River water; 6. Underground water; 7. Sea water.

1. *Ice and Snow* are characteristic of all regions where the conditions of temperature and atmospheric pressure are such as to maintain the water in its solid forms. It usually obtains thus during wintry seasons in the temperate zones, and permanently on mountain snow-slopes and glaciers, at altitudes of from eight to ten thousand feet and upwards above the sea-level, and in the circumpolar areas. Frozen water is, as a rule, almost free from impurities; and, when liquefied, yields a remarkably pure fluid, in which dissolved mineral salts and suspended solid particles are only accidental.

Unlike most substances, water expands on cooling. But only between the limits of 39 25° Fahr. and 32° Fahr.; it becomes frozen, and in virtue of its relative lightness remains on the surface of the water. The lower levels are thus prevented from radiating heat into space, and the warmth so necessary to the maintenance of life is thus retained by the earth. The bracing climate of a mild wintry country is too well known and appreciated by those who live in it to require any comments here. If we were writing a treatise on domestic medicine, we would consider it our duty to devote at least one chapter to ice and snow. In the kitchen, ice is a most desirable luxury; and in the preservation of diets, we have but to turn for a tangible example to the gridiron of Messrs. Bertram & Roberts, at the foot of the passage leading to the Aquarium in the Exhibition buildings, to enjoy an excellent, well-matured mutton chop all the way from New Zealand.

2. *Rain, Dew, and Hoar-frost.*—The properties of these waters have already been detailed at some length.* The usefulness of rain-water depends to a very large extent upon its softness and freedom from suspended particles. It is, perhaps, the largest source of supply of practically pure natural water in existence. Of possible impurities, dust and dirt, leaves and twigs, soot and ashes, traces of such acids as hydrochloric, sulphuric, and nitric acids, sulphates, chlorides, and ammonia, besides the gases of the air, are liable to affect rain-water most of all.

Dew, the frozen variety of which is termed hoar-frost, generally contains a somewhat larger percentage of soluble and suspended impurities than rain water, which it abstracts from the air. In England, it has been shown that dew possesses 4·87 in 100,000 parts of solid impurity, and about ·198 parts of ammonia.† In our remarks upon the formation of dew,‡ we noted that a deposition of moisture from the invisible vapour held in the atmosphere takes place when the moisture-laden medium comes into contact with bodies which are ever so little colder than it is itself; the exact temperature at which this occurs can be ascertained by means of a little instrument called after its inventor, Daniell's ether hygrometer, and is termed the *dew point.* On a clear night the leaves of plants, &c., radiate more heat into space than they receive back, and are thus rendered colder than the surrounding air, and, in consequence of this, dew is formed; on a cloudy night, however, the heat is radiated back by the clouds, and the deposition of dew thus curtailed. During the summer months, an immense amount of vapour is taken up by the warm air, and, as the nights are usually clear, enormous quantities of dew are produced and absorbed by the vegetation and surface soils of the earth. This state of affairs is, of course, more pronounced in tropical countries, where the source of water-supply through the agency of dew is an all-important factor in the maintenance of the conditions of life during the protracted period of drought commonly called the "dry season."

3. *Marsh and Pond Waters* are local collections of rain, or, in the neighbourhood of sea-coasts, of rain and spray. They usually harbour vegetable and animal growths and decaying matters; and upon the absence or presence of these, in larger or smaller quantities, does the value of the water entirely depend; it may thus range from a good, soft water to one which may be described as the essence of contamination.

4. *Lake Water* may represent the accumulated drainage of a large area which empties into a natural reservoir. The character of the water, which is primarily derived from rain, thus depends wholly upon the nature of the surrounding formations. The water of lakes without efferent streams, generally becomes saline, through evaporation and con-

* *Ut supra*, p. 34, *et sequentes.*
† "Rivers Pollution Commission," 6th report, p. 32.
‡ See this Journal, p. 34.

sequent precipitation and re-solution of dissolved mineral salts, often to a prodigious degree. In the well-known Dead Sea, in Southern Palestine, one gallon of the water weighs about 11¾ lb., or 1¾ lb. more than a gallon of ordinary fresh water. Other lakes, as the salt lakes of Utah and Russia, are almost, if not quite saturated solutions; whilst still others afford a further stage in being destitute of liquid water; of this character is the borax lake of California. Doubtless the presence of mines of salt in this country, Prussia, and elsewhere, point to former lacustrine deposits which have taken place under analogous operations on the surface of the earth or in vast underground reservoirs.

Other lakes are merely expanded portions of rivers, or depressions occasioned by glacial erosion; and they are commonly provided with both affluent and effluent streams. In such cases the waters are, of course, identical with those of rivers; their physiographical surroundings, however, make them the recipients of the first upland drainage, and, as a rule, the water-supply from such sources is particularly free from impurities. As instances we may point to the waters of classic Loch Katrine, with its "silver strand" and "Helen's Isle," and of Thirlmere, in Cumberland; they contain only about two grains of solid impurity in each gallon.

5. *River Water.*—Enough has been stated with regard to the sources of the Thames water to afford a typical example of what may be expected from a river-supply of water.

6. *Underground Waters* furnish us with by far the most extensive supply in the world. We must once more refer our readers to our foregoing remarks, from which they will gather that rivers and lakes are very largely augmented, and that springs and wells are wholly derived from subterranean sources. A species of intestine warfare seems to be perpetually carried on between the pure and impure varieties of this element beneath the surface of the earth; and, on the whole, a kind of equilibrium is established. Surface-waters which become contaminated by their passage through dissolvable soils and rocks, are operated upon by the counter effects of internal heat and other agencies; they are compelled to give up portions of what they have taken, and may thereafter find an escape to the surface of the earth, from which they originally came, considerably purified. On the other hand, they may reappear surcharged with the substances they have collected on the way. As a rule, however, the tendency of extensive underground circulation is to render the water purer in the sense of its becoming more valuable to man, and these changes are chiefly brought about through the oxidation or destruction of harmful organic matters, which may accrue from sewage, graveyards, abundant manuring, decaying vegetation, &c.

7. *Sea Water* occupies but a subordinate place in ordinary domestic economy. Its saline character is chiefly due to the continued accession of dissolved salts from the earth, which are brought to it by rivers, and which remain behind in the water whilst evaporation is constantly going on from its surface. As a bath, sea-water is often more invigorating than fresh water. In the vessels of the British Navy, and in many recently-built crafts, the waste steam from sea water is utilised by condensation, aërated, and used for drinking and culinary purposes. If a quantity of fresh water be represented by a weight of 1,000 lb., an equal volume of sea water would weigh 1,027½ lb. In consequence of this the boiling point of sea water is much higher than that of fresh water, because an additional amount of heat is necessary to overcome the adhesion between the water and the saline matters.

(To be continued.)

THUNDERSTORMS.

THIS is a topic to which we shall, when an opportunity presents itself, have occasion to refer with a view to demonstrate that it is possible to guard against such annual calamities as frequently accompany lightning discharges.

On the three closing days of the week ending July 5 thunderstorms of more than ordinary violence passed over England and Scotland. Reports show considerable loss of human life and destruction of property. The storms were accompanied by heavy showers of rain and hail. Some of the hailstones, when picked up, were found to measure seven-eighths of an inch square, and weigh over two pennyweights. Subjoined is a summary compiled by a contemporary of the effects produced in England and Scotland.

ENGLAND.

Aston, near Wallingford.—Two men, while working in a field, were killed. Their clothing was completely consumed. A horse in the neighbourhood was also killed.

Burnley.—Two men were seriously injured.

Liverpool.—At Holy Trinity Church the lightning passed through the roof and through the gallery floor, filling the building with a pale blue flame. The current passed between two boys, paralysing the arm of one and scorching the boot of the other. The bell was rendered useless, and coping stones were hurled some distance.

Peterborough.—A number of sheep and cattle killed.

Weardale.—Wesleyan Chapel struck, and two men at work on the spire were knocked down insensible, but recovered consciousness afterwards. At Burn Hope a house was partially destroyed.

Northampton.—Lightning struck several dwelling-houses, demolished the turret of a shoe factory, and injured a girl.

Wymeswood.—Three men, who were at work in the hayfield, took shelter under a hedge. One of the men felt a sharp pain on his thigh, and became insensible. On recovery he found that one of his companions had fallen, while the other was sitting, looking placid and apparently undisturbed; but on examination he found both were dead.

Skipton.—Tree struck and cut, and a cartload of hay which was being put into a barn set on fire.

Wingham.—A stable on the farm of Sir Brook Bridges was struck by lightning and set on fire, three valuable horses being burnt to death.

Cambridge.—A woman was killed and several buildings were struck by lightning,

Deddington.—A painter was killed whilst sitting under a tree during a thunderstorm.

Consett.—Whilst nursing an infant on his knee a miner was struck by lightning and killed, the child escaping.

SCOTLAND.

Hamilton.—The storm, which was at its height about half-past one, continued for fully two hours. About half-past one o'clock, what is described as a ball of fire burst over the Clydesdale Bank, a large three-storey structure in Cadzow-street. The lightning struck the chimney head, racking and displacing the solid stonework, and passing, it is believed, down the chimney. The consternation of the inmates, including the officials of the bank, may be conceived. In the room with which the vent communicated, the grate was thrown out on to the floor, and the apartment filled with soot, plaster, and *débris*. Something similar happened in the room on the second floor. The bank office is immediately below on the street floor. The accountant was startled by the noise and falling *débris*.

Mr. Lightbody, who was standing inside his shop door on the opposite side of the street, was almost knocked off his feet against the side of the door. His workmen in the bakehouse behind thought the premises had been struck, and the beam and scales were knocked against the wall. The tailors in Mr. Park's workshop, which adjoins the bank, felt stunned, and thought their skylight window had been struck. Three independent witnesses standing in the neighbourhood at the time state that they noticed a ball of fire momentarily suspended over the bank.

Lockerbie.—Several houses struck and their roofs damaged.

Kilbirnie.—Two houses damaged; the lightning passing from the one to the other.

Beith.—Intense darkness accompanied the storm, and business had to be suspended for fully an hour, during which time flash succeeded flash at intervals of four minutes.

Ardrossan.—The most severe storm ever experienced. The flashes of lightning were very vivid, and the peals of thunder sharp and loud. Hailstones, weighing over two pennyweights, and measuring three-quarters of an inch in circumference, were picked off the streets.

Saltcoats.—Two houses struck, and their gas-pipes cut in two.

Kirkintilloch.—The lightning entered the room of a house, passed along the attics and out by the chimney, shattering the plaster and chimney top.

Rothesay.—Valuable milch cow killed.

Vale of Leven.—Darkness intense. The flashes of lightning very vivid, and the peals of thunder, which were loud, continued from ten to twenty seconds.

Stonehouse.—Hailstones of large size, vivid lightning, and a series of tremendous sharp, and prolonged peals of thunder. Cow killed and a tree struck.

Newmilns.—Thunder peal followed thunder peal in rapid succession, and sometimes three of them were heard at the same time. Outside stair and belfry of the Council Chambers damaged.

Loans.—Two cows and a bull killed.

Sinclairtown.—Dwelling-house struck, followed by an explosion of gas; damage not serious. Stack of hay set on fire and completely destroyed.

Kirkcaldy.—Ventilator at the top of malting kiln at Gallatown struck, and one of the large beams supporting the ventilating apparatus shattered, some of the splinters being carried away a distance of about 200 yards. In a private house a valuable picture was destroyed, and the woodwork set on fire.

Stanley.—A house was set on fire, and a portion of the structure knocked down on two women, rendering them insensible for a time.

Stow.—Eight sheep instantaneously killed, and a ninth had to be afterwards destroyed.

Hawick.—The storm lasted for upwards of two hours, and so dark was it that gas had to be lighted. The lightning entered two houses and damaged a number of articles.

Girvan.—Several cattle killed.

Busby.—The lightning was most brilliant and vividly coloured, blue in many instances. From three to four flashes were seen before thunder heard. Three girls employed in Busby Mills fell into a state of fainting, and remained in a trance for several hours. A cow grazing in a field was killed, its hide being singed. A building in the printworks was stripped of the lead and slates.

Ayr.—The lightning very bright and the thunder almost incessant. Several of the flashes were of a violet tinge. Some little panic was created in Ayr woolworks by the girls getting frightened at the lightning gleaming on the spindles.

Leith.—The lightning entered a house, ran round the cornice of a room, tearing it open. The window-curtains were set on fire, the roof singed, and a number of articles which were lying about damaged. The lightning escaped through the window, scorched the framework, and smashed several panes of glass. A gentleman sleeping in the room had a very narrow escape, as the lightning in its course went within a few feet of his head; he was much shaken. After leaving the house the lightning had, judging from a quantity of plates dislodged, run down the outside of the house and entered the earth.

Edinburgh.—The *Scotsman* says:—"Just as the storm began, one of the telegraph clerks in the *Scotsman* office had a narrow escape from being injured by the lightning. Word had come over his wire that the House of Commons had been counted out at 2.30 a.m., and he rose from the Morse instrument to carry the sheet into the adjoining sub-editor's room. As he re-entered the telegraph room a loud report like the discharge of a rifle was heard, and the thick glass cover of the relay was blown several feet into the air, and smashed one of the glass globes. The relay was completely destroyed.

Dumfriesshire.—Reports give accounts of considerable destruction of farm stock. Mr. Phillips, Clarencefield, had two fine bullocks killed, Mr. H. Baird, Blackford, had one killed, and Mr. Aitken, a farmer in the parish of Johnstone, had sixteen sheep killed. While a lad was harrowing turnips in a field the lightning struck the ground in the next ridge, and covered him with earth, and a man leading a horse had a very narrow escape, he having just passed when a large tree was struck and thrown across the road. Heavy rain accompanied the storm.

Arisaig.—Mr. Lewis Macdonald (28 years of age), crofter, Ardnish, was on the hill above the croft, taking home the cattle at about 4 p.m., on Friday last week, when he was struck with lightning and killed instantly. When found it was discovered that there was a mark like a bullet hole on the right side of the head above the ear, and from the appearance of the body it is evident that the electric fluid struck his head first, and then passed through his body.

Appin.—There were several extremely vivid flashes of forked lightning passing straight down from a dense cloud overhead to the earth. Four sheep were struck by lightning and killed; and altogether the storm was one of the most severe remembered for some years.

ERRATA.—P. 57, col. 2, line 8 from bottom, "now tired," should be "never tired. P. 60, letter 1340, line 1, "absence of home" should be "absence from home."

RAINFALL RECORDS AT GLASGOW OBSERVATORY.—On the authority of Professor Grant, F.R.S., some interesting rainfall records at Glasgow Observatory have been made available for public use. Their publication was suggested by the heavy rainfall at Glasgow during the twenty-four hours ending at ten o'clock on the morning of the 11th inst., which is said to have been the most excessive that has occurred during the past twenty-two years. The downpour was heralded by a smart shower which commenced about 1 p.m. on the preceding day (Thursday), and lasted but a few minutes, when fair weather was again enjoyed for about an hour. A little after 2 p.m. there was registered by the self-recording instrument of the observatory, a drenching shower, which, although happily shortlived, was remarkable for the rapidity with which it fell. At 4.15 p.m., the sky, which was destitute of sunshine for several hours previous, again sent down rain in perfect torrents. During the evening, 1 in. of rain fell in five hours. During the twenty-hours referred to, the rainfall amounted to 2·12 in., and during none of the twenty-two years preceding 1884 did the rainfall at Glasgow Observatory ever exceed 1·77 in. in the same period of time. That was in the month of July, 1866.—*Engineering.*

Reviews.

SOME BOOKS ON OUR TABLE.

Text-Book of Descriptive Mineralogy. By HILARY BAUERMAN, F.G.S. (London: Longmans, Green, & Co. 1884.)—In his volume on "Systematic Mineralogy," in Messrs. Longmans' admirable series of "Text-books of Science," which preceded the one whose title heads this notice, Mr. Bauerman considered the methods followed in the systematic determination of the form, structure, and composition of minerals, and he now proceeds to apply such determination to the description of every important species known. This is done in a way as convenient and intelligible to the student as it well can be, and no less than 203 woodcuts of crystalline forms illustrate the text. It is curiously illustrative of the advance of mineralogical science that the capital index (of the names of minerals alone) with which Mr. Bauerman's work concludes occupies twenty closely-printed columns.

Simple Lessons in Water-Colour: Marine. By EDWARD DUNCAN. (London: Blackie & Son.)—In no more agreeable form can reminiscences be secured of a holiday tour than in that of water-colour sketches, made by the tourist himself, of the localities which he has visited; and the sea-coast will always supply him with a boundless variety of subjects for his pencil. Mr. Duncan's book will furnish him with all needful information as to the best method of reproducing the various forms which he will meet with, and the atmospheric effects which add so much to their charm and beauty. The possession of a box of moist water-colours, a sketch-block, and this volume of "Simple Lessons" will add a new and very real pleasure indeed to a visit to the sea-side.

Tea and Tea-Drinking. By ARTHUR READE. (London: Sampson Low, Marston, & Co.)—Mr. Reade, who is very keen and enthusiastic indeed about tea, does his best, and far from unsuccessfully, to interest the general reader in the same subject. Beginning with its introduction into this country in 1610, and tracing the gradual spread of its use, he goes on to describe its growth and preparation, teaches us how to make it, discourses on its effects on physical endurance, its employment as a stimulant, and winds up with some details of the extent to which it is a source of revenue. The book is both chatty and amusing, and will while away an idle half-hour pleasantly enough.

John Bull's Neighbour in her True Light. By a "BRUTAL SAXON." (London: Wyman & Sons. 1884.)—How far what may be termed an International "Slanging-match" is a seemly or edifying spectacle, must be left to the judgment of individual readers. Within a comparatively recent period, however, certain French writers have taken upon themselves to revile and vituperate England and the English in a manner which was certain sooner or later to provoke reprisals. That the inhabitants of these islands are faultless, either morally or socially, it would be idle to contend; that, however, on the other hand, we are the besotted, debauched, ignorant poltroons depicted by some of our highly-imaginative neighbours across the Channel, it would be equally idle not to deny. Stung, then, apparently by taunts as baseless as they are brutal, our author, who seems to be an English resident in Paris, has set himself to let a little light in upon French life, social and official; and a most melancholy *exposé* he gives us of ghastly immorality, filthiness, bragging, cowardice, and venality on the part of our critics. The "Brutal Saxon" is, at any rate, both eadable and amusing, and probably by this time MM. Max O'Rell," Hector France, et Cie, are (like Lord S haftesbury's parrot) "sorry they spoke."

The Straight Line and Circle. With a Chapter on the other Conics. By A. LE SUEUR, B.A. Cantab. (London: Baillière, Tindall, & Cox.)—This handy little rudimentary book on Analytical Geometry and the Conic Sections will be found useful to the student preparing for examination. A very excellent feature in Mr. Le Sueur's work is the insertion after the proof of the various formulæ, of exercises, in the shape of numerical applications of them. Nothing, in our experience, appeals so immediately to the mind of the beginner as a concrete numerical example of a merely literal equation, and such examples are supplied in abundance in the book before us. General ones are also given at the ends of the chapters on the line and circle, as well as the questions set at the London University Examinations for the B.A. and B.Sc. degrees from 1840 to 1883. The author has done his unpretentious work well.

The Blowpipe in Chemistry, Mineralogy, and Geology. By Lieut.-Colonel W. A. Ross, R.A., F.G.S. (London: Crosby Lockwood & Co. 1884.)—This is apparently a reprint of a series of articles which originally appeared in our contemporary, the *English Mechanic*. Be their origin, however, what it may, there can be no doubt of the value and utility of these lessons in what their author appropriately calls "Poor Man's Chemistry." No one can read Colonel Ross's book without recognising the power and usefulness of the method of anhydrous analysis which he so lucidly explains; and we have little doubt that the perusal of his book will tend to bring into fashion a mode of recognising mineral substances at once so simple, cheap, and efficacious as to render it remarkable that it should ever have been suffered to fall into desuetude. Nothing can be plainer or more perspicuous than our author's description of the apparatus employed and the method of using it.

Calculating Scales. Designed and patented by LALA GANGA RAM. (London: W. F. Stanley.)—A week or two ago we reviewed (p. 36) a tract of General Hannyngton's in which he gave a description of an extension of the slide rule for the purpose of executing logarithmic computations; and now there lies before us an illustrated description of another form of the same instrument, devised by a well-known Indian Civil Engineer for finding the scantlings of timber, strains on girders and trusses, the thickness of retaining walls or by inspection. These scales ought to be useful to the working civil engineer.

In the Watches of the Night. Poems (in eighteen volumes). By Mrs. HORACE DOBELL. Vol. II. (London: Remington & Co., 1884.)—As an example of moderately bad poetry it would be hard to find anything more illustrative than this series. Take one at random, "Sea Shells and their Tenants":—

> And the little fish slip in and out,
> In the still calm hours of the June moonlight;
> And the wild winds rock them oft about
> In the tempest rude of a summer night.

And so on through 96 pages. Mrs. Dobell's "Watches" should be wound up forthwith.

We have also before us *Moffat's Test-papers* (London: Moffat & Page); Part 18 of *The Franco-German War*, Part 18 of *The Library of English Literature*, Part 2 of *European Butterflies and Moths*, all published by Cassell & Co., London; *The Subsidence Theory of Earthquakes*, by Dr. Keeland; *Compulsory Uniformity of Weight in the Sale of Corn*, by T. H. Chatterton; *The Journal of Botany*, (London: West, Newman, & Co.); *Suggestions for Popular and Educational Museums*, by Thos. Laurie (London: the Author); *The Tricyclist; The South American Journal; The Railway Review; The Boot and Shoe Trades Journal*; and the *The Hindu Excelsior Magazine* (Madras).

Miscellanea.

THE percentage of recruits in the Italian army who can neither read nor write varies from 27 in Piedmont to 74 in Sicily.

THE *Insurance Critic* asserts that there are more than 10,000 steam boilers in New York city, attended by 7,000 men, of whom not one-seventh are believed to be trustworthy and qualified for their responsible work; and yet dynamite cartridges are a terror to many people.

ACCORDING to Mr. Chamberlain, 120 applications for provisional orders have been made to the Board of Trade since the passing of the Electric Lighting Act. Of these 73 have been granted by the Board of Trade and confirmed by Parliament. There have been ten applications for licences. One for Colchester was to be granted in the course of a few days. The remainder have not been proceeded with by the applicants. The supply of electricity has not been commenced under any of the orders.

ONE of the most accomplished writers and artists of the day has recently been spending a short period in Holloway Gaol, as an imprisoned debtor, the object being to thoroughly show up and expose the gross iniquities of our law under which debt is still by a fiction treated as a crime. The series of prison sketches and notes will be commenced in *St. Stephen's Review* of the current week, under the title "Notes from a Debtor's Dungeon," and will rival the famous work of the "Amateur Casual."

ELECTRIC CONDUCTIVITY OF SOLUTIONS.—According to the recent researches of M. Bouty, the neutral salts in very extended solutions of water form a group apart as regard their electric conductivity. For example, ethylic alcohol, glycerine, erythrite and phenol, glucose and candied sugar, ordinary ether and dichlorhydrine, ethylic aldehyde and acetone, as well as albumen, all conduct very badly. M. Bouty has also come to the conclusion, from his experiments, that an anhydrous alkali or acid is not a conductor, but that a hydrated acid or alkali conducts like a salt.—*Engineering*.

WE have received from Messrs. Rowney & Co., Oxford-street, a specimen of "Wood's Adjustable Geometrical Ruler," which combines in a box of a very portable form, measuring 14½ inches by 2½ inches, an ordinary ruler, a T square, set square, protractor, &c., and a new contrivance for drawing and dividing circles and geometrical figures. After a little attention and practice the instrument will prove very handy and useful to any one who has frequent occasion to construct figures, etc., which by the ordinary rules of geometry take a considerable time in working.

ALMOST all the Sicilian sulphur ore is carried to the surface on boys' backs, consequently it does not pay to work below about 400 ft., as it then becomes necessary to employ hauling machinery. Hence the deposits lying below that level are hardly touched, and as many of the beds are nearly vertical, and do not diminish in yield as they descend, the still untouched resources must be very great. Various estimates have been made as to the period for which the supply will last at the present rate of consumption; these range from 50 to 200 years. There are said to be about 250 mines in the island, and no less than 4,367 calcaroni were reported in operation fifteen years ago. The average yield is stated not to exceed 14 per cent.

AT a recent Conference held at the Health Exhibition, it appeared from some statistics collected by Dr. Ord that gardeners had a better chance of life than any other class out of some eighty specified classes of workers, with the exception of clergymen. If 1,000 be taken as the average standard number of deaths within a given period among all classes taken together, then the number of gardeners who die during the period is barely more than half the average—*i.e.*, 559; that of clergymen, who have the best chance of all, 556; agricultural labourers, 653; farmers, 675; medical men, 1,125. The highest death-rate is among persons engaged in hotels, 2,205; inn-keepers, 1,521; brewers, 1,361—significant figures these! The proportion of medical men who die in a given time, though above the general average, is less than might have been expected from the harassing life they mostly lead, and the special risk they run.

THE PHYSIOLOGICAL ACTION OF HELODERMA POISON.—That this lizard, the Gila monster (Heloderma suspectum) is venomous, has been often asserted and as often denied. Weir Mitchell and Reichert find that its mouth-liquids are highly poisonous, killing frogs, pigeons, and rabbits in a few minutes. This establishes it as the only venomous lizard known. What is of even more interest, perhaps, is the fact that the physiological action of the poison is quite different from that of snake-poison: the latter kills essentially by paralysing the respiratory centre, the former by paralysing the heart. Heloderma venom causes no local injury when injected subcutaneously; and arrests the heart in diastole, from which condition the organ slowly passes into a contracted state. The heart-muscle entirely loses its irritability when the organ ceases to beat, and when other muscles and the nerves still readily respond to stimulation. The spinal cord is paralysed.

ELECTRIC LIGHTS FOR LIGHTHOUSES.—General Duane has, since August last, been carrying out a series of experiments as to the applicability of electric lights for lighthouse work for the United States Lighthouse Board. The experiments have been carried out at Tompkinsville, Staten Island, the electric portion being under the charge of Lieut. John Millis. The present result of the experiment is that the electric light is found to be ten times more powerful than the oil light, and that for a given amount of light it is the cheaper of the two. It is said that of the apparatus tried the most useful has been found to be that at present in use in the French lighthouses. Among the dynamos tried have been the Gramme, Elphinstone-Vincent, Siemens, and Weston. The report on these experiments is not expected to be ready for some months yet, but when it does appear it will be of the greatest interest. If the report of the committee now engaged in the same kind of experiments for the Trinity House at the South Foreland should appear contemporaneously with that of General Duane some interesting comparisons might be made.—*Electrician*.

WHATEVER degree of truth may attach to Lamartine's remark that before the present century shall have run out Journalism will be the whole press of the world—the whole of human thought—there can be no doubt that the profession is becoming one of increasing importance, and one that attracts an ever-growing number of followers. Many an aspirant for journalistic fame is, however, at a loss how to set about the realisation of his ambition, and a good handbook or guide affording trustworthy information as to the qualifications necessary for each branch of the journalistic profession has not hitherto been available. With a view to supply this want a series of articles has been commenced in the *Printing Times and Lithographer* for July, dealing with every phase of the subject. The articles are from the pen of Mr. A. Arthur Reade, well known as the author of the "Literary Ladder," "Study and Stimulants," "How to Write English," &c. The popularity which these several works have enjoyed entitles one to anticipate an equally favourable reception for the present series of articles, which have, moreover, had the benefit of revision by a number of leading journalists.

AUSTRALIAN TIMBER.—A Board appointed to inquire into and experiment on the best kind of timber grown in the Australian colonies, and adapted for the construction of railway vehicles, has sent in its report. Among the woods which the Commissioners mention as suitable are blackwood, mountain ash, bluegum, and Gippsland mahogany. Under test the blackwood presented results which were superior to any other timber. The mountain ash was second to the blackwood for railway purposes. It should be felled, the Commissioners think, during the winter months, when it has attained maturity, and is between 4 ft. and 5 ft. in diameter, and it might remain felled for six months before being broken down into planks for seasoning. Bluegum should be treated in the same manner. Going somewhat beyond its reference, the Board deals with the question of timber licenses, and recommends that getters be compelled to pay for the timber felled, and to confine their operations to a given area, or otherwise that selected lots of trees be sold by tender. It is also strongly recommended that a forest board should be called into existence. [The above, taken from *Engineering*, serves to show that the continually-increasing demand for timber is causing considerable anxiety, not only in Europe and America, but in every quarter of the civilised world.]

A VALUABLE contribution to the literature of physical astronomy * has recently been made in the issue by the Bureau of Navigation at Washington of Parts I. and II. of Vol. II. and Part I. of Vol. III. of "Astronomical Papers prepared for the Use of the American 'Ephemeris and Nautical Almanac.'" In the first of these parts the formulæ necessary for expressing the corrections to the geocentric right ascension and declination of a planet are deduced in terms of correction to the elements; the expressions thus obtained being deduced to numbers for the planets Mercury and Venus, and tables for those two planets respectively being appended. The second part of Vol. II. contains investigations of corrections to the Greenwich Planetary Observations, 1762–1830; and, to the general reader, will probably be found the most interesting of the three, if it be only for the succinct history of the instruments employed at

* We use these words in the original and legitimate sense, and by no means in the modern one of watching sunspots to predict rain and periods of stock-jobbing insolvency.

our British National Observatory (and the nature of their errors) during the period specified. Part I. of Vol. III. of these "Astronomical Papers" is purely technical, and is "On the Development of the Perturbative Function." In it the subject is first treated analytically in an exhaustive manner, and the tables are appended for the numerical development of it. It is instructive to compare the liberal and judicious expenditure of the Government of the United States in perfecting their National Ephemeris, with the parsimony of that of our own country in connection with our *Nautical Almanack*, in which, to take a single example, the phenomena of Jupiter's satellites are still computed from the imperfect and erroneous tables published by Damoiseau nearly fifty years ago. This will serve as well as anything to illustrate the merely mechanical—or barrel-organ—kind of principle on which the annual calculations are ground out in Verulam Buildings. Meanwhile, any one who is sufficiently pushing and impudent, and can obtain the ear of members of the Government personally ignorant of science, seems to have no difficulty in dipping his hands into the public purse. If the money, absolutely and utterly wasted every year on a shallow sham called "The Committee on Solar Physics," at South Kensington, were devoted to the improvement of the *Nautical Almanack*, the advantage to astronomical science could hardly fail to be very great indeed.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the* EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C. IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

***All Remittances, Cheques, and Post Office Orders should be made payable to* MESSRS. WYMAN & SONS.**

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

DICKENS'S STORY LEFT HALF TOLD (No. 139).

[1343]—Being the writer of what Mr. Thomas Foster calls "a recent rather feeble article on the subject in the *Cornhill Magazine*," I should like, with your permission, to make a few observations.

Not having read "Leisure Readings," I am not well aware what Mr. Foster's theory really is, and should therefore be glad to learn in what number of KNOWLEDGE his former article on this subject appeared.

Until I have had the pleasure of reading it, I will only ask whether Mr. Foster has seen the article, "How Edwin Drood was Illustrated," which appeared in the *Century Magazine* for February, 1884?

From that I quote the following few sentences:—"The central crime of the book can never have been intended by the author to be a mystery; the secret that Charles Dickens intended to keep, and kept in effect, was the manner of the discovery. He is a keen reader who has ever found out who and what was Mr. Datchery, and of this Mr. Fildes knows no more than does the public."

"But, finding that Mr. Fildes knew a great deal, Charles Dickens went on to make the principal revelation which concerned the central figure; he told his illustrator that Jasper was to be brought to justice in the end of the story. A drawing of this originally and most strongly-conceived criminal locked up in the condemned cell (which was to have been studied at Rochester) was then planned between the two as one of the final subjects."

Mr. Foster contends that Edwin Drood is alive, though Jasper does not know it. That he should keep his very existence a secret for six months—causing terrible grief to Rosa and others—for the purpose of taking a deadlier vengeance in the end on Jasper, does not, I confess, appear to me reasonable; but then I suppose I am what Mr. Foster calls "a commonplace reader."

In conclusion, I may mention that I received letters from two gentlemen—both strangers to me—insisting that Baggard is Datchery. One wrote from Boston, U.S., the other from Jersey. But on this point I agree with Mr. Foster, and differ from my correspondents as widely as their homes are distant. H. E.

[As Mr. Foster is, I imagine, by this time on the other side of the Atlantic, a fortnight or three weeks must certainly elapse before I can receive any reply or comment on the above letter from him. —ED.]

THE SOLAR GLOW.—VENUS IN INFERIOR CONJUNCTION.

[1344]—In connection with the letter (1342, p. 61) of "Cosmopolitan," it may be of interest to mention that I have received a letter from that careful and painstaking observer, Mr. T. R. Clapham, of Austwick Hall, near Lancaster, describing the appearance of the solar glow as seen by him on the 12th inst. It was (naturally) most favourably seen when the sun himself was obscured by a cloud, leaving the surrounding sky clear. Under these circumstances, the ruddy glow seemed very approximately to follow the outline of the cloud; but there was also one fine reddish streamer, with almost parallel edges, above the cloud; in shape, exceedingly like one of the beams of light visible when, as the country people say, "the sun is drawing water." This is illustrated by a water-colour sketch, which could not, of course, be reproduced here in colour. My correspondent goes on to say that the afterglow was stronger on the night of July 13 than he had known it for some weeks. Assuredly there is *something* still permeating the atmosphere in its upper regions.

Mr. Clapham adds that at 10h. 30m. a.m. on Saturday 12, he could easily see the dark body of Venus with a 3¼-in. Wray telescope; but that he could not trace the dark limb right round. I mention this because on the previous day at 10h. 41m. a.m., I saw precisely the same thing with my 4·2 in. Ross equatorial, armed with a power of 154; the dark limb of the planet being traceable for a considerable distance beyond the cusps, but fading into the bright sky in its southernmost portion. WILLIAM NOBLE.

Forest Lodge, Maresfield, Uckfield, July 18, 1884.

THE "WAR OFFICE GHOST."

[1345]—I take the following particulars from Wallace's "Miracles and Modern Spiritualism," pp. 72-3, where I happened to read it yesterday.

Captain Wheatcroft's "ghost" appeared, not only to his wife—who by the way was in bed at the time—but to another lady, in London. On inquiry, R. Dale Owen (from whose narrative Wallace draws most of his facts) gathered from this lady and her husband that it was about 9 p.m. of Nov. 14, 1857, that the spirit appeared in uniform. He was struck by a fragment of shell, it seems, in the breast, on the afternoon of the 14th, not the 15th, as the War Office certificate first put it. The times, therefore, are within the limits required on the assumption, which is quite unnecessary, that the apparition occurred *simultaneously* with the death. If anything really hinged on the exact synchronism it might be worth while to make more minute inquiries as to the circumstances of the Indian battle-field. But I really see none. It is quite sufficiently convincing as it is, so long as nothing essential is authoritatively denied. J. HERSCHEL.

[Mr. R. Dale Owen can scarcely be accepted as a trustworthy authority on anything whatever having reference to the "supernatural." Readers interested in the spiritualistic imposture will not have forgotten his famous article in the *Atlantic Monthly*, on the bona fides of the apparition of "Katie King," through the mediumship of a Mr. and Mrs. Nelson Holmes; nor his subsequent humiliating confession of the way in which those people had humbugged him. If Mr. Wallace has no better voucher for his "facts" than Mr. Owen, assuredly they must be taken with something more than a grain (say a salt-cellar full) of salt.—ED.]

A COINCIDENCE.

[1346]—In May last, a friend mentioned to me in conversation a poem by the late Dean Stanley, entitled "The Untravelled Traveller," and addressed to Prince Leopold on the latter's recovery from a severe illness at Oxford. I had never seen or heard of the poem before, and my friend, who was extremely anxious to procure a copy, begged me to let him know if I ever met with it, as he did not know where it was to be found. We then spoke of other things, and no further allusion was made to the subject—in fact, I quite forgot it till the next morning, when, quite casually taking up a small monthly magazine (which, by-the-by, I seldom

XUM

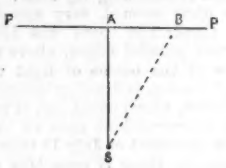
read) from my sister's writing-table, almost the first thing that met my eye was a reprint of this very poem. It would have been the last place I should have thought of looking in.

ARDENNES.

PERSPECTIVE.

[1347]—Some of your correspondents seem to have got into a puzzle over their perspective. They seem to find a difficulty in understanding how parallel lines perpendicular to the line of sight—that is, lying in planes parallel to the plane of the picture, can be correctly presented to the eye of the spectator by parallel lines on the plane of the picture.

Your correspondent "C. E. Bell" seems to forget that, although the upper and lower edges of the cube may be shown by parallel lines in the picture, yet the *angle subtended with the eye* by the perpendicular edges of the cube varies with the distance to right or left, as the case may be, while the edges are from the centre of the picture or line of sight.



Thus, if PP in the annexed diagram be the plane of the picture shown in plan, S, the spectator's eye, and SA, the line of sight, it is obviously seen that a given dimension M on the plane of the picture at A will subtend a larger angle with the eye than the same dimension M at B.

Let "R. Jones," "C. E. Bell," and others simply examine the photograph of any rectangular object taken with the plate of the camera parallel to one face of the object, and they will find that all the horizontal lines in the object which are in planes parallel to that of the plate will appear as parallel lines in the picture.

In connection with this subject I would remark that artists are in the habit of showing the sea-line as a straight horizontal line. Now this is not strictly correct, and especially when the sea is viewed from a great height.

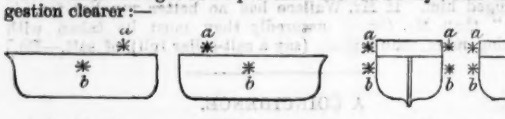
The spectator's eye being a point outside a sphere, may be regarded as the apex of a flat cone, the base of which is a circle whose radius is (approximately), the distance of the spectator from the horizon.

If a straight-edge be held up to the eye when looking towards the sea-line from a lofty cliff on the sea-shore, the curvature of the horizon becomes plainly visible. I commend this experiment to crazy Zetetics, though, doubtless, they can explain this as easily as every other fact that tells against them. E. W. YOUNG.

[What *is* "a flat cone"?—ED.]

SHIPS' LIGHTS.

[1348]—Apropos of your propositions respecting ships' lights in "Sent to the Bottom," in a former number of KNOWLEDGE, the reduction of the number of lights being most desirable, may I venture to offer for your consideration the following alteration, namely, that *two* lights on each side only be adopted, in lieu of three side and two end lights. Thus, let the foremost light be white on each side, and visible from right ahead to right astern, and placed 15 (?) feet from the sternmost, and 5 (?) feet above that light—the sternmost light to be particoloured—white showing ahead to well abeam, but say red astern to nearly abeam; steamships carrying a fifth masthead light as at present. A sketch may make my suggestion clearer:—



Starboard. (White.) Port. (White.) Ahead. (White.) Astern. (*a*. White.) (*b*. Red.)

The opening apart of the lights from a perpendicular line, as when seen from "right ahead," to their greatest distance apart, as when seen from "abeam," and their closing again, the lower becoming red, to their original position, as when seen from "right astern," would indicate the required information as to course of observed ship. The *regulation* interval between the lights being invariably adopted, would become by habit easily and surely recognisable as representing by their varied proximity the direction and distance of the observed ship.

I leave this suggestion with you, as you may in a few moments run over an imaginary series of positions as depicted in your excellent magazine, substituting the two lights alone in lieu of the five there shown, bearing in mind, at the same time, that ships at sea are not, as a rule, on an even keel or even beam, so to put it. A ship, say 30°—nay, 40°—out of the perpendicular, as often happens, and at a time when lights are most requisite and important, would materially alter the relative length of the perpendicular side of your triangle, and that of each of the other two. I recognise that that upright side forms the gauge by which the apparent lengths of the other two are measured, and so the course of the vessel estimated. What, therefore, are we to do to obtain that information when our gauge or foot-rule is liable to considerable variation from this heeling over of the ship at sea? Let it also be remembered that *perpendicular space* available for effectively showing lights from the side of a ship is very limited. What would our lee triangle be like with our bottom light in danger of entire submersion. The side lights now are carried almost invariably several feet above the top rail of bulwarks for this very reason, and if placed much higher would be eclipsed by the sails. All this, and more, I am sure, will present itself to your mind, and I need enlarge no further. My best thanks are due to you for many most instructive and enjoyable hours spent in company with you in KNOWLEDGE from No. 1.—I am, sir, &c., CHAS. RICE.

TESTS OF DIVISIBILITY.

[1349]—In letter 1334 (p. 39) I stated that 999 . . . to $(n-1)$ figures can be divided by n without remainder whenever n is prime to 10. I find it is not so.

When n is a *prime number* it will divide 999 . . . . to $(n-1)$ figures.

When n is composed of *unequal* factors a, b, c, &c., the number of 9's required is $(a-1)\ (b-1)\ (c-1)\ \ldots\ .$, or some factor of this.

When n contains *equal* factors (=say, $a^p b^q c^r \ldots .$), the number is

$$a^{p-1}(a-1)b^{q-1}(b-1)c^{r-1}(c-1)\ \ldots\ .$$

or a factor of this.

Thus the number of 9's required can never exceed $(n-1)$.

W.

LETTERS RECEIVED AND SHORT ANSWERS.

FITZGREEN. The word "aperture," in the reply to which you refer, had reference to a refractor, but 2½ inches was a misprint for 2¼ inches. This would have an approximate focal length of 30 inches, and would cost between £7 and £8. An instrument furnished with a 2½-inch object-glass would be of about 3 feet focus. Either of these would bear a power of 200 on close double stars; the latter even a somewhat higher one. No reflector of less than 3½ inches aperture is of the slightest use.—CASTOR. The cause to which you refer, viz., the production in the offspring in an aggravated form of diseases common to their consanguineous parents, is the generally-accepted reason given against marriage between cousins. On the other hand, as you say, two people standing in that relation, each healthy and of exceptional intellectual power, might fairly be expected to beget a high type of children. Still, every agriculturist knows the evil of "breeding in and in"; and what is so well established in the case of the brute creation may reasonably be held to apply to man in his animal relations.—A. C. D. C. suggests, in connection with a statement on p. 23 as to the origin of a rite held as sacred by Christians, "that Mr. Clodd should show that a similar one was observed in any religious system previous to the introduction of Christianity." He also finds fault with Mr. C.'s assertion that "the eastward position is the undoubted relic of worship of the rising sun," with which I am considerably more surprised, inasmuch as I imagined that this was admitted as an indisputable fact by all save a very few bigoted and ignorant people indeed.—W. A. LEONARD. Thanks, but I have already declined a series of articles on the same subject from a thoroughly competent member of our own staff.—J. MURRAY. The apology is sufficient.—SIGMA. Your reasoning is utterly fallacious. You deal with infinity as a quantity which can form a member of an equation! Were this possible, you might *multiply* it; but you can no more talk of five times infinity than you can of nothing². An "infinite circle" is

absolutely unthinkable. It can have neither centre nor circumference.—W. BROOKS SAYERS. Would you be surprised to hear that a gentleman named Aristarchus of Samos (who died B.C. 212) anticipated you in your idea of determining the distance of the sun, by observing the angle subtended by him and the dichotomised moon, some 2,160 years ago? From the practical impossibility, however, of ascertaining when the moon is exactly half-full, he made out that the sun's distance from the earth was only nineteen times that of the moon; whereas, as we know, this is less than a twentieth part of its true value. Your absurd endorsement of "private" on your letter has delayed it exactly a week.—GARTH WILKINSON opines that the vaccine eruption is contagious.—T. MANN. The principal movements of the earth are:—1. The annual. 2. Her motion round the centre of gravity of herself and the moon. 3. The diurnal. 4. What you speak of as the precessional, or that conical motion of her axis which gives rise to the Precession of the Equinoxes. 5. The Nutational. 6. The secular change in the obliquity of the ecliptic. 7. The revolution of her apsides. 8. The secular variation is the eccentricity of her orbit, and, 9, her motion in space in common with the whole solar system. The contributor to whom you refer seems to have forgotten his promise.—A. MACKAY. See reply to you on page 61 and paragraph on page 62.—JAS. GILLESPIE. Do, for goodness sake, master the rudiments of your subject. Do you know that the earth's mean equatorial semi-diameter only subtends an angle of 8·85″ at the Sun, and that the Pole Star *is* actually vertically overhead in latitude 88° 41′ north? Polaris is not in the pole of the heavens, but 1° 19′ from it. You seem hopelessly incapable of comprehending that at the enormous distance of the fixed stars all lines simultaneously drawn to them from any parts of the earth's surface are parallel—nay, that so remote are they that even the diameter of her orbit shrinks to a point as viewed from them! —J. GREEVZ FISHER sends me "Five Rulez for Improving Spelling," for which I am much obliged; but fancy that I shall continue to employ, for some little time to come, orthography so thoroughly "understanded of the people" as that which he seeks to supersede.—POLYGLOT. Thanks. Certainly not at present.—NIGEL DOBLE. Premising that 66 inches is a ridiculously inadequate focal length for a 6-inch object-glass (which would perform infinitely better if it had a focus of 90 inches). I may tell you that you would need at least four eye-pieces for astronomical purposes, which, with a 66-inch objective, would be constructed as follows, each, of course, consisting of two plano-convex lenses, with the plane sides next the eye. No. 1 field-glass 1·65-inch focus, eye-glass 0·55-inch focus, 1·1 inch apart. This would give a power of 80. No. 2 field-glass, 0·73 inch focus, eye-glass 0·24 inch focus, 0·48 inch apart. This would magnify 180 diameters. No. 3 field-glass, 0·53 inch focus, eye-glass 0·18 inch focus, 0·36 inch apart. This would magnify 250 times. And No. 4 Field-lens, 0·26 inch focus, and eye-lens 0·09 inch focus, 0·17 inch apart. This would give a power of 500 for very close double stars. Each of these eye-pieces should have a diaphragm, to limit the field of view, placed in the focus of the eye-glass. I do not know the work you mention.—MALCOLM FYFE. The perusal of your letter suggests the dictum of the great American philosopher: "There's nothing new, and there's nothing true, and it don't much signify." In everything of the slightest value you have been anticipated by Mr. F. H. Wenham and others—years ago.—AUGUSTUS J. HARVEY suggests the appointment of a staff of commissionaires to conduct visitors to the principal points of interest of the Health Exhibition, and to explain the most important objects shown there.—THE PRESIDENT AND COUNCIL OF THE SOCIETY FOR THE STUDY AND CURE OF INEBRIETY. I regret that I was a good many miles from London on the evening of the 21st.—H. W. JACKSON. Please communicate with Messrs. Wyman & Sons, the publishers of KNOWLEDGE.—LAW. Prior to the receipt of your letter I was ignorant that there were any Whitworth *Law* Scholarships at all.—W. E. SNELL. No one, that I am aware of, has ever disputed in these columns the value of sanitation as one form of prevention of small-pox.—A. MCDONNELL. I will read your pamphlet as impartially as I can.—EYE-WITNESS. Something of the sort was attempted on p. 247 of our last volume, but did not seem to meet any general want. My large star-atlas would enable you to learn the constellations.—G. PINNINGTON. "I think *not*," says the lamb.—G. C. I do not know the particular book you mention, but the names of its joint authors afford a sufficient guarantee of its excellence. Bloxam's is *my* text-book. Churchills publish it, and it is first-class, but it cost rather more than your specified price.

In response to numerous applications, it has been decided to issue "The Index" to Volume V. of KNOWLEDGE, *with the present number, free of charge.*

Our Mathematical Column.

NOTES ON EUCLID'S SECOND BOOK.

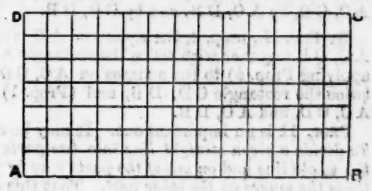
BY RICHARD A. PROCTOR.

(*Continued from p.* 41.)

IT is well to notice the algebraical and arithmetical relations which the different relations presented in the preceding propositions serve to illustrate.

We must show first that if each of the two lines which contain a rectangle can be divided into an exact number of parts each equal to some unit of linear measurement, then the product of the two numbers represents the number of corresponding units of square measurement contained in the rectangle.

Let the rectangle A B C D be contained by the lines A B, A D; and suppose that a certain unit of length is contained 13 times in A B and 7 times in A D. Then if A B be divided into 13 equal parts and A D into 7 equal parts, each part of each line is equal to this unit of length. And



if we draw through the points of division in A B lines parallel to A D, and through the points of division in A D lines parallel to A B, it is clear that the rectangle A B C D will be divided into a number of squares each having its sides equal to the unit of length. Now each row of squares parallel to A B contains 13 such squares, and there are seven such rows. Therefore the whole rectangle contains 7 times 13 squares. Thus the product of the numbers 7 and 13, which represent the length of the sides in terms of the linear unit, gives us the number representing the area of the rectangle in terms of the corresponding unit of square measurement. And the proof would have been precisely the same whatever the number of units of linear measurement in the sides A B, A D,—so that, if A B contains a such units, and A D contains b, the rectangle A B C D contains $a\,b$ units of square measurement.

It would be easy to extend this proof to the case of a rectangle having incommensurable sides; but for the purpose of illustration the case of commensurable sides is sufficient. This commensurability is to be understood as implied in what follows.

In Euc., Book II., Prop 1, if the undivided line contain a units of length, the several parts of the divided line b, c, and d units, respectively, the proposition corresponds to the algebraical identity

$$a(b+c+d)=a\,b+a\,c+a\,d.$$

Prop. 2.—If the undivided line contain $(a+b)$ units of length, its parts a and b units correspond to the identity

$$(a+b)a+(a+b)b=(a+b)^2$$

In Prop. 3, on the same supposition, the algebraical identity corresponding to the proposition is

$$(a+b)b=a\,b+b^2.$$

Prop. 4, on the same supposition, corresponds to the identity

$$(a+b)^2=a^2+2\,a\,b+b^2$$

In Prop. 5, let A B $=2a$, and C D $=b$, so that A D $=(a+b)$ and D B $=(a-b)$ then the corresponding algebraical identity is

$$(a+b)\,(a-b)+b^2=a^2$$

that is, the well known relation

$$a^2-b^2=(a+b)\,(a-b).$$

But if we put A D $=a$ and D B $=b$, we obtain the relation—

$$a\,b+\left(\frac{a-b}{2}\right)^2=\left(\frac{a+b}{2}\right)^2;$$

that is, the well known formula—

$$(a+b)^2-(a-b)^2=4\,a\,b$$

We get the same identities in the case of Prop. 6, if we make corresponding suppositions, simply interchanging a and b.

In Prop. 7, put A C $=a$, and B C $=b$, then the algebraical identity corresponding to the proposition is

$$(a+b)^2+b^2=a^2+2b\,(a+b)$$

In Prop. 8 put A C $=a$, and B C $=b$; then the corresponding algebraical relation is

$$4(a+b)b+a^2=(a+2b)^2.$$

In Prop. 9 put first A B $=2a$ and C D $=b$; then the corresponding algebraical identity is

$$(a+b)^2+(a-b)^2=2(a^2+b^2).$$

Next put A D $=a$ and D B $=b$, and we obtain the relation

$$a^2+b^2=2\left(\frac{a+b}{2}\right)^2+2\left(\frac{a-b}{2}\right)^2$$

XUM

which is not a new relation, the change in our suppositions merely leading to the inversion of the former relation.

In Prop. 10 corresponding suppositions with the interchange of a and b give the same results.

It will be found that any theorem respecting rectangles may be shown to correspond to an algebraical identity,—and in like manner that any homogeneous algebraical identity of two dimensions may be made to supply one or more geometrical theorems respecting rectangles.

Let us take as an instance the following identity :—

$(a+b+c)^2=a^2+b^2+c^2+2ab+2bc+2ca$; this resolves itself into the following proposition :—

PROP. I. *If a straight line* A B *be divided into any three parts in the points* C *and* D ; *then the square on* A B *shall be equal to the squares on* A C, C D, *and* D B, *together with twice the rectangles contained by* A C, C D, *by* A C, D B, *and by* C D, D B.

By Euc. II., prop. 4, the square on A B is equal to the squares on A C, C B together with twice the rectangle A C, C B ; that is (again applying Prop. 4) to the squares on A C, C D, D B, together with twice the rectangle C D, D B, and (Prop. 1) twice the rectangles A C, C D, and A C, D B.

PROP. 11 is an important one. It may be enunciated also thus,—*To divide a given straight line into two parts so that the squares on the whole line and on one of the parts may be together equal to three times the square on the other part.* That this enunciation is equivalent to the other follows immediately from Prop. 7. Prop. 11 offers a problem somewhat more difficult than most of those in Euclid. It is made use of by him in Book IV. Prop. 10 ; but when it is required for the solving of Prop. 30, Book VI., he appears to have forgotten that he had already solved it, and adopting a less happy mode of analysing it occupies three long propositions with its solution. We shall note an analogous proposition in our next contribution on this subject.

(*To be continued.*)

Our Chess Column.

By MEPHISTO.

THE FRENCH DEFENCE.

1. P to K4 / P to K3.

THIS is a perfectly sound and safe defence, and suitable whenever the second player wishes to play a close game or avoid the more attacking lines of play arising from 1. P to K4 ; White's best reply is 2. P to Q4 / P to Q4. If now P × P, then P × P followed by Kt to KB3, B to Q3, and Castles with a safe game. White may also play 3. Kt to QB3 / Kt to KB3—B to Kt5 would not lead to any favourable result. White now would not gain anything by advancing P to K5, as, after Kt to Q2, Black would vigorously attack the centre by P to QB4, Kt to B3, &c. If 3. P × P, P × P, and we have a normal position which Black follows up by B to K2 and Castles. White has now two lines of play, viz. :—

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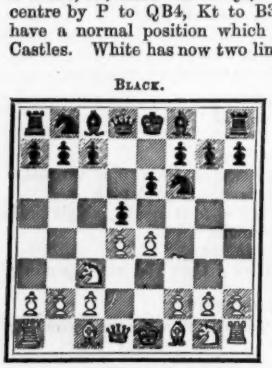

WHITE.

B to Q3 and B to KKt5. If

4.	B to Q3	P × P
5.	Kt × P	B to Q2
6.	Kt to K2	B to B3
7.	P to B3	B to K2
8.	Castles	Castles

and in this variation White has a good position. It might perhaps have been better to play 5. P to QKt3, followed by B to Kt2, as that would leave the square on B3 open for the Knight. If instead

4.	B to KKt5	B to K2
5.	B × Kt	B × B
6.	Kt to B3	Castles
7.	B to Q3	P × P
8.	B × P	Kt to B3

With two Bishops on the board, Black need not be afraid to have his Pawn doubled, the position being an even one.

SELECTED PROBLEMS.

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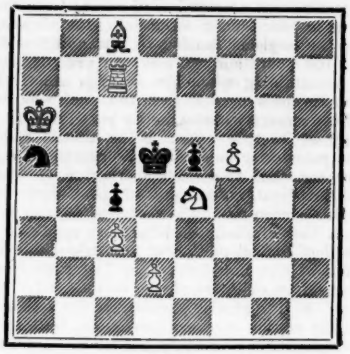

WHITE.

White to play and mate in three moves.

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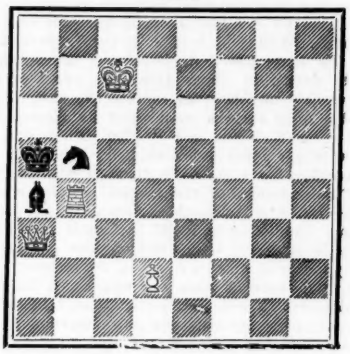

WHITE.

White to play and mate in two moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Frankford.—If 1. Q to K3, P to Kt6, 2. Kt to K6(ch), K to Kt5, 3. Q to Q5, K to R6.

Geo. W. Thompson.—Solution not quite correct. 1. Kt to B3, 2. Kt to Kt3(ch), Q × Kt, 3. Kt to Q7(ch), Kt × Kt.

George Gouge.—1. Kt to Bsq, 2. Kt × P, and mates next move.

Correct solutions received from M. T. Horton and A. Rutherford.

The Owl.—Part solution correct.

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